

UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION

WORK AND PROGRESS OF THE AGRICULTURAL
EXPERIMENT STATION FOR THE YEAR
ENDED DECEMBER 31, 1918

BULLETIN 113

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UNIVERSITY OF IDAHO

Agricultural Experiment Station

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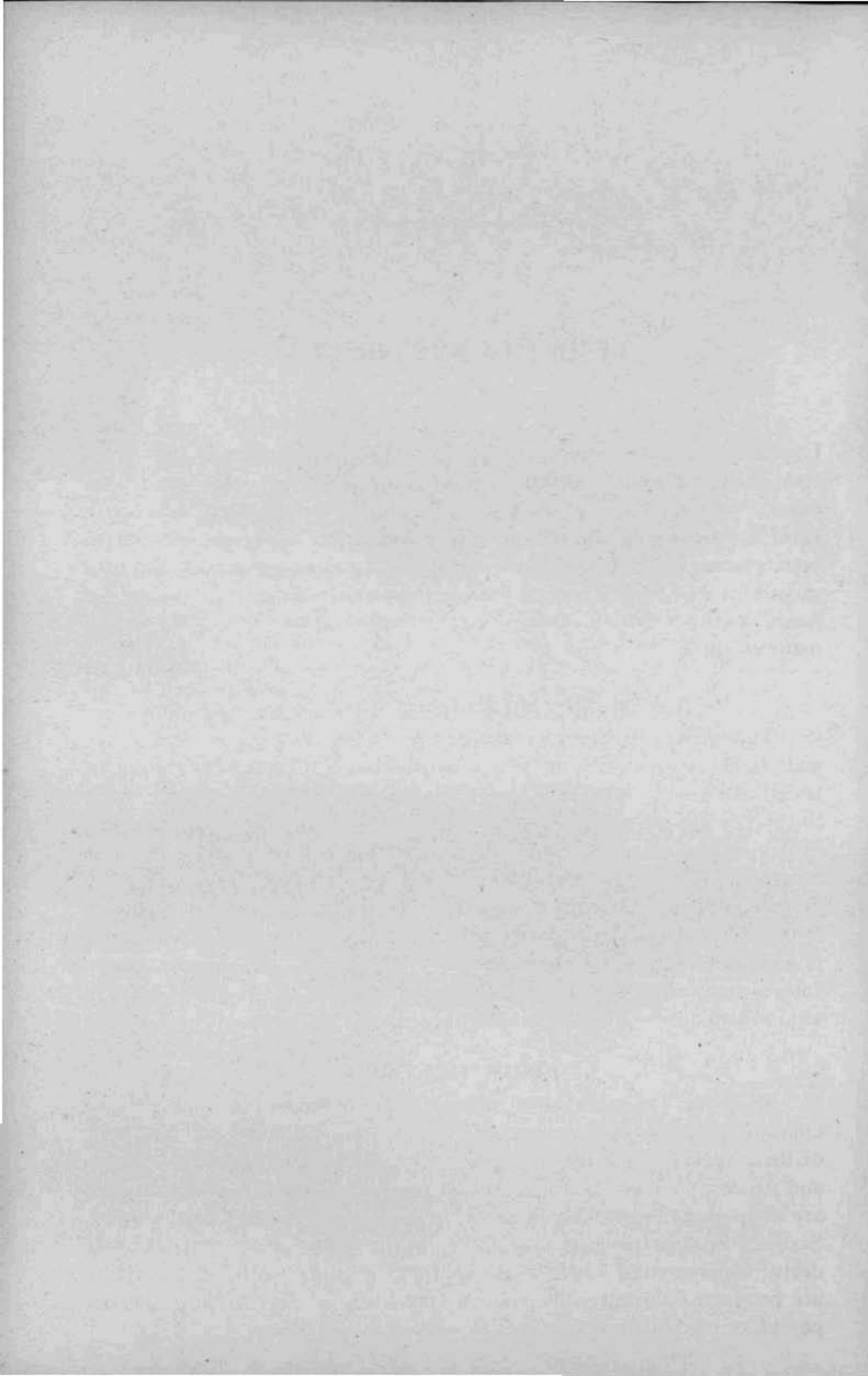
To the President of the University of Idaho:

The Federal Hatch Act establishing Agricultural Experiment Stations and approved March 2, 1887, provides that "It shall be the duty of each of said Stations annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said Stations, to the said Commissioner (now Secretary of Agriculture) and to the Secretary of the Treasury of the United States."

In accordance with the provisions of this Act, I am submitting herewith for transmission to the Governor of Idaho a report of the work and progress of the Agricultural Experiment Station of the College of Agriculture of the University of Idaho, for the year ending December 31, 1918.

Respectfully submitted,

E. J. IDDINGS, Director.



REPORT OF THE DIRECTOR

The past year has meant for progress in the work of the Agricultural Experiment Station. Certain important lines of investigation have been completed and results published or are now ready for publication. New experimental projects have been undertaken; an additional substation farm has been definitely located and development work started; station results have played an important part in the increased production and conservation work; station workers have rendered valuable service in the American Army, in the Red Cross, in various drives for funds, and in many minor fields of war activity.

STATION ACTIVITIES STATE WIDE

The activities of the Experiment Station extend to many parts of the state. The Central Station Farm at Moscow consists of 375 acres of leased and deeded land; the Caldwell Substation, 320 acres; the Aberdeen Substation, 80 acres; the High Land Experiment Station at Felt, 160 acres of dry farm land and 40 acres of irrigated land; the Substation Farm at Sandpoint, 170 acres, and the well improved Experimental Farm at Jerome, 40 acres. Another point from which station work is conducted is the Entomological Substation at Twin Falls, where Mr. R. H. Smith is located for work with clover aphid. The Experiment Station, therefore, is state-wide in its work, and influence, and has to do with problems vital to the state's agricultural development and prosperity.

FEDERAL SUPPORT

With the exception of support of the substation farms and small appropriations for soil survey and insect pest investigation, the work of the Experiment Station is supported by the two federal funds, Hatch and Adams. Under the Hatch Act, 29 projects or separate pieces of work are supported, while nine projects are supported by the Adams Fund. Sixteen separate projects carried on by members of the Station staff derive support from such special appropriations as mentioned above, or are conducted during spare time by men who are on the instructional payroll of the University.

HATCH FUND PROJECTS**Animal Husbandry.**

1. A Study of the Leading Breeds of Sheep with Special Reference to the Factors Influencing Production.
2. The Growing and Use of Silage Crops other than Corn for Feeding Beef Cattle and Sheep.
3. Hogging-off Field Peas.
4. Forage Crops for Swine.
5. Economical Rations for Finishing Swine.
6. Economical Rations for Finishing Lambs.

Chemistry.

1. Silage Investigations.
 - (a) The Acidity of Silage made from Sunflowers, Beet Tops and Artichoke Tops.
 - (b) Digestion Coefficients of Sunflower and Beet-Top Silage.
2. The Ash of Irrigated and Non-Irrigated Fruits.

Dairying.

1. Experiments to Find Relation between Barley and Corn Meal in the Ration for Dairy Cattle of the Northwest.

Farm Crops.

1. Variety Tests, Selection and Breeding of Small Grains.
2. Winter Barley Culture.
3. Forage Crops—Culture and Improvement.
4. Variety Tests, Selection and Improvement of Field Peas.
5. Cultural Experiments with Field Peas.
6. Variety Tests, Selection and Improvement of Field Beans.
7. Cultural Experiments with Field Beans.
8. Corn Breeding.
9. Root Crops—Culture and Seed Production.

Horticulture.

1. Summer versus Winter Pruning Experiments.
2. Small Fruits Experiment.
3. Variety Tests of Vegetables.
4. Strawberry Variety Tests.
5. Apple Variety Tests.
6. Potato Experiments.
7. Experiments with Tomatoes.
8. Experiments with Cabbage.
9. Experiments with Garden Beans.

Poultry Husbandry.

1. Feeding for Egg Production.

Soils.

1. Crop Rotation and Fertilization Experiments.
 - (a) Plots at Moscow and Sandpoint.
 - (b) Co-operative Work with Farmers.

ADAMS FUND PROJECTS**Bacteriology.**

1. The Influence of Various Woods on Bacterial Activity in the Soil.
2. The Relation of Nitrates to Nodule Formation.

Chemistry.

1. Factors Influencing the Protein Content of Wheat.
 - (a) Correlation of Available Soil Nitrogen and the Protein Content of Wheat.
 - (b) Baking Studies on Types of Idaho Wheats.
2. Factors Influencing the Ripening of Fruits, particularly Apples.

Dairying.

1. A Study of the Type of Organisms Present and Multiplying in Cottage Cheese.

Horticulture.

1. Apple Breeding.

Soils.

1. Duty of Water.
2. Alkali Investigations.

Zoology.

1. Cytological Studies.
 - (a) Additional Cytological Studies of the Reproductive Cells of the Mule.
 - (b) Cytological Studies of the Reproductive Cells of Cattle.
 - (c) Cytological Studies of the Reproductive Cells of Sheep.

Projects Supported by Maintenance Funds or Special State Appropriations.**Agricultural Engineering.**

1. Farm Sewage Disposal.

Bacteriology.

1. Commercial Preparation of Culture for the Inoculation of Nitrogen-gathering Bacteria.

Dairying.

1. Scoring Contests of Commercial Creamery Butter.

Farm Crops.

1. Questionnaire on Field Peas and Beans.

Forestry.

1. Forest By-products.
2. Experimental Tree Planting.
3. Grazing Studies.
4. Agricultural Possibilities of Logged-off Lands.

Poultry Husbandry.

1. Poultry House Construction.
2. Poultry Management.

Pure Seed.

1. Field Visitation, Encouragement of Crop Diversification, Assistance in Marketing of Seeds, Development of Seed Growers' Associations.
2. Investigation—Weeds, Cost of Producing Clean Seed.
3. Weed Survey.
4. Laboratory Work—Analytical.
5. Inspection.

Soils.

1. Soil Survey.

Zoology and Entomology.

1. A Study of Clover Aphis and Methods for its Control.

Aberdeen Substation.

1. Dry Farming Investigations.
 - (a) Small Grains and Flax Varietal Tests.
 - (b) Varietal Tests with Peas and Potatoes.
 - (c) Rate, Date, Depth and Method of Seeding Winter Wheat.
 - (d) Tillage Experiments.
 - (e) Experiments in Cultivation of Winter Wheat.
 - (f) Crop Rotations.
 - (g) Alfalfa and Sugar Beet Seed Investigations.
2. Experiments in Crop Production under Irrigation.
 - (a) Small Grain and Flax Varietal Tests and Cereal Nursery.
 - (b) Varietal Tests of Field and Garden Peas and Beans for Seed Production.
 - (c) Alfalfa and Clover Seed Production.
 - (d) Potato Varietal testing, Tuber improvement and experiments in Methods of Production.
 - (e) Sugar Beet and Mangel Seed Production.
3. Seed Marketing.
4. Extension and War Service.

Caldwell Substation.

1. Variety Testing.
2. Pork Production.
3. Dairy Herd Management.
4. Forage Crop and Grain Production.
5. Soil Management and Improvement.

High Land Experiment Station at Felt.

1. Experiments with Varieties and with Cultural Methods for Grain and Forage Crop Production under both Dry Farming and Irrigation at an Altitude in Excess of 6000 Feet.

Jerome Substation.

1. Potato Cultural Investigations.
2. Experiments with Canning Peas and White Pea Beans.

Sandpoint Substation.

1. Clearing Land—Hogging-off Work.
2. Cereals and Forage Crops.
3. Milk Production under Conditions prevailing in the cut-over areas.

Hatch Projects Yield Results.

Significant and highly valuable results have been secured in carrying on Hatch Fund projects during the past year. New silage crops have been successfully grown and fed to live stock, and valuable information has been secured by station chemists with reference to the development of acids in silage crops and silage crop mixtures. The variety and cultural tests with field peas and variety tests with corn by the Farm Crops Department have been especially successful. Under conditions comparable to those of the open field a yield of 84 bushels per acre was obtained with a particular variety of field corn, Rustler's White Dent. Calls for seed of this corn come from a wide territory.

The Horticultural experiments in vegetable gardening and in evaporation and canning have been of immense practical benefit in the conservation campaign of the past year. The department of Poultry Husbandry has clearly shown that animal protein in some form is necessary for profitable egg production. The addition of sour milk to a vegetable protein ration resulted in increased egg production of something like 1000 per cent. The soil rotation and fertilizer experiments indicate an increased wheat yield of 22 per cent from the use of barnyard manure. All of the work mentioned above was supported by the Hatch Fund, which consists of an annual appropriation from the United States Treasury of \$15,000, to be expended with the approval of the Federal Office of Experiment Stations.

Adams Fund Results.

The Adams Fund, a Federal appropriation of the same amount as the Hatch, by the terms of the bill making the grant, is used for carefully outlined investigations of a fundamental scientific nature. Substantial progress has been made on the projects heretofore listed. A report in bulletin form is nearing completion on the investigation of the relation of soil nitrate to nodule formation. A number of trees in the apple breeding experiment are now bearing fruit. The newly accepted project in cytological studies promises valuable scientific information with reference to the problems of heredity. A new publication from the department of Chemistry reports conclusive evidence of a direct relation between soil nitrates and the protein content of wheat.

Other Projects.

The University-made culture for the inoculation of peas, beans, clover, and alfalfa has been used extensively. A sufficient price per acre has been charged, 20c during 1918, to cover the cost of material and labor, with exception of the supervision of the trained bacteriologist in charge. The department of Agricultural Engineering is rendering effective assistance in handling problems of farm power and farm buildings.

The tested trees of the School of Forestry are increasingly popular. The special appropriation for insect pests has been entirely expended in studying the clover aphid and testing methods of control. A bulletin reporting highly valuable information in regard to successful control measures is ready for public distribution.

Substation Farms.

The substation farms, with the exception of those at Aberdeen and Jerome, have had inadequate support. The Aberdeen Farm is supported jointly by State and Federal funds, and the Jerome Station entirely by Federal funds. The present arrangement at Jerome results in strict Federal management. The Aberdeen Substation is becoming an influential factor in agricultural progress in southeastern Idaho. Including the 1918 cropping season, about two-thirds of the eighty-acre farm at Aberdeen has been used for dry farm investigations. The entire farm will hereafter be used for crop production experiments under irrigation. A separate tract is being sought for dry farm investigational work. Clearing and other land improvements and certain revision of operating methods and of experimental projects are planned in handling the Caldwell and Sandpoint Substations. Both stations possess marked possibilities for community and state-wide service. Much is hoped in the way of interesting and highly valuable information from the new High Land Experiment Station in Teton County.

Changes in Staff.

As a result of war measures, numerous changes have taken place in the Station staff. There have been ten resignations, two leaves of absence for the period of the war, and seven new appointments.

Publications.

Members of the Experiment Station staff have contributed numerous articles of a popular nature to the University News Letter and to various agricultural and technical journals. These contributions, together with the bulletins and circulars of the Station, were effective agencies in the food production and conservation campaigns. The list for the year of bulletins, circulars and technical papers follows:

No.	Title and Author.	Pages.	Copies.
103	Performance Records of Some Eastern Wheats in Idaho, J. S. Jones, C. W. Colver, January, 1918.	32	4,000
104	Annual Report for Year ending December 31, 1917, J. S. Jones.	52	2,500
105	Trees—What, Where, When and How to Plant, C. H. Shattuck, I. W. Cook, February, 1918.	68	5,000
106	The Home Garden in Idaho, W. C. Edmundson, J. S. Welch, February, 1918.	32	12,500
107	Soils of Latah County, Idaho, P. P. Peterson, May, 1918.	24	2,000
108	Sprays for the Control of San Jose Scale, W. C. Edmundson, February, 1918.	16	10,000
109	The Protein Content of Wheat Under Irrigation, J. S. Jones, C. W. Colver, H. P. Fishburn, December, 1918.	40	5,000
110	Drying and Serving Fruits and Vegetables in the Home, C. C. Vincent, Jessie M. Hoover, June, 1918.	32	15,000
111	Power Farming in Idaho, J. C. Wooley, September, 1918.	16	15,000
112	A Study of Clover Aphis and Methods for its Control, R. H. Smith, December, 1918.	16	12,000

No.	Title and Author.	Pages.	Copies.
113	Annual Report for the Year ending December 31, 1918, E. J. Iddings.	48	2,500
5	(Circular) Tested Forest Trees for Planting in Idaho, F. G. Miller, January, 1918.	4	10,000
6	Idaho Spray Calendar, C. C. Vincent, M. A. Willis, March, 1918	8	15,000
	Journal of Agricultural Research, Vol. XII, No. 4. Influence of Nitrates on Nitrogen-Assimilating Bacteria. T. L. Hills. Reprints furnished for Idaho Experiment Station.		
	Journal of Agricultural Research, Vol. XIV, No. 10. Acidity of Silage made from Various Crops. Ray E. Neidig. Reprints furnished for Idaho Experiment Station.		

Mailing List.

During the past few weeks the entire experiment station mailing list has been revised. It was found advisable to eliminate approximately thirty per cent of the names because of inaccuracy or duplication of addresses. Other names have been added upon request and all active Idaho farm bureau members are included in the permanent list. Bulletins of a general and popular nature are sent to the entire mailing list. Bulletins of a technical nature or such bulletins as would only interest certain people are sent to portions of the list or upon request.

The summarized mailing list is as follows:

Resident of Idaho.....	8,937
Residents of other states.....	2,955
Foreign	175
<hr/>	
Total	12,067

The News Letter.

The plan of handling the Bi-weekly News Letter has been much improved during the year. Instead of a single sheet printed on one side only, the new form, four and one-half by eleven inches, consists of two leaves and four printed pages. A committee of three edits all copy with the purpose of placing matter before News Letter readers in a clear and interesting way. The News Letter is sent to all residents of Idaho whose names are on the regular station mailing list and to certain agricultural journals, and Federal, state, and college officials in other states. Approximately nine thousand five hundred copies are distributed from each issue.

Library.

The burning of the Administration Building several years ago destroyed the early files of bulletins, and new files have been assembled only after the exercise of patience and perseverance. At the present time the bulletins, reports, and other library material of interest to agricultural instructors and to research men in agriculture is not in such condition that it can be used to the best advantage. It is highly important that sufficient help be provided in the library so that one worker can be assigned to that portion of it to arrange the bulletins and reports of particular interest to the Agricultural College and Experiment Station, and that liberal

provision be made for binding, in order that valuable publications may be put in a more permanent form.

Insect Pests.

A sum of four thousand dollars was provided by the 1917 legislature for insect pest investigation and control, and has been expended entirely in work with the clover aphid. Such progress has been made that it seems possible to entirely control this pest, which in some districts in southern Idaho has almost entirely destroyed the profitable industry of clover seed production. In order that this work may be completed and other important problems undertaken, an appropriation of \$6,000 is requested for the coming biennium.

State Funds For the Experiment Station.

With the exception of support of the substations and appropriations for such special work as soil survey and insect pest control, there has been no State support for the work of the Idaho Experiment Station. With no other support than the Hatch and Adams funds mentioned before, it is impossible for the Station to do the work that should be done in Idaho, and to serve the agricultural needs of the state in handling a large number of problems that concern the agricultural development and the future prosperity of the farming population.

A request is made of the incoming Legislature, therefore, for a specified amount, to be expended entirely for experimental work in agriculture. This money will supplement in a number of directions the work of the Hatch Fund, and particularly will enable the work of the Station to be much more valuable to the State as a whole.

A matter of prime consideration is the employment of an experienced and trained man for experimental work in Animal Husbandry and the use of a portion of the proposed state appropriation for the development of a feeding station on the experiment farm at Caldwell. The feeding problems, particularly those of southern Idaho, are complicated, and the Station is not in possession of information that enables it to answer many inquiries. The problem of providing a satisfactory method of utilizing, in the community where grown, the great yields of alfalfa hay is alone of sufficient importance to justify the appropriation of a considerable sum.

Other lines of work that are needed are in crop production, irrigation, drainage, land clearing and investigation of other similar problems of very great importance in Idaho.

AGRICULTURAL ENGINEERING

J. C. WOOLEY

Since June 15th of this year the Agricultural Engineering Building and entire equipment have been used in soldier training. At that time an assistant was employed, and 20 enlisted men were enrolled in auto mechanics. On August 15 another assistant was added, and 40 men taken for training; and two months later five more assistants were employed and 150 men entered upon auto mechanics training. A total of 210 soldier students completed the technical eight weeks' course.

This war emergency service forced the neglect of regular departmental work. Special attention has been given, however, to a power farming survey, tractor demonstrations, farm building plans, and farm water supply and sewage disposal.

Power Farming.

A survey of the State was made to determine the number of tractors in use and with what success they were being operated. The names of 800 Idaho owners were secured and questionnaires sent them. The information recorded in the questionnaires was summarized and the results made available for general use in Station Bulletin No. 111.

Tractor Demonstrations.

Three tractor demonstrations, at Vollmer, Grangeville, and Boise, were organized and managed by the head of the department. These demonstrations have been of great value to owners and prospective buyers, and have shown to the public that a tractor will do the work it is designed to do. It has been found that the tractor will not work successfully in mud or on steep hills, but if handled intelligently and with a reasonable amount of skill on a farm suited to tractor use it will work with speed and efficiency.

Farm Buildings.

To assist the farmer in getting the best in construction and arrangement of his buildings, blue print service was offered. The plans sent out included only those known to be suitable for Idaho conditions. The following have been distributed during the past year:

One hundred plans of the "Woods" type poultry house, designed by the departments of Agricultural Engineering and Poultry Husbandry; 25 copies of the "Idaho Sunlit" hog house, designed by J. C. Wooley; a number of plans for a half monitor hog house similar to the one used on the University Farm, a sheep feeding rack approved by the University, and plans of a lambing shed designed by one of Idaho's leading sheepmen.

Farm Water Supply and Sewage Disposal.

The increasing demand for modern homes has led to numerous inquiries in regard to plans for water supply and sewage disposal. Plans were made for installation suitable for farm use in Idaho and these plans were made available for general use through a publication of the Extension Division.

Projects have been planned on agricultural engineering features of irrigation and drainage, and the addition of a specialist in these lines will make possible some much needed work.

ANIMAL HUSBANDRY

C. W. HICKMAN, O. E. McCONNELL

It has been a very difficult year in which to carry on station work in animal husbandry on account of the high cost of livestock used in such work and the very high cost of all feeding stuffs. In addition to the above, there have been several changes in the personnel through resignations to enter military service.

Study of Breeds of Sheep.

Some phases of this project will need to be continued. Considerable data are at hand in regards to certain production factors of five leading breeds of sheep.

Silage Crops Other Than Corn.

The growing and use of silage crops other than corn should be continued. The Giant Russian Sunflower was grown this year for the first time. Fall sown wheat and rye with winter vetch were planted this fall for next year's silage. Peas and oats gave a very low yield as compared with former years, due to the extremely dry season.

Forage Crops for Swine.

The project on hogging-off of field peas should be continued. Tests of forage crops for swine should be carried out on a larger and more comprehensive scale than heretofore. A bulletin dealing with hogging-off field peas will be issued early the coming year. This same work should be continued at the Caldwell Substation as well as at Moscow.

Peas and Millfeeds for Swine.

The hogging-off work with peas was not so successful during the summer of 1918, because of the extremely dry season. In order to obtain information in regard to the value of peas as a hog feed, 32 spring shotes are being fed rolled barley and peas in various proportions, as follows:

Lots I. and II. Peas and barley, equal parts.

Lots III. and IV. Peas three parts, barley one part.

Lots V. and VI. Peas one part, barley three parts.

Lot VII. Barley alone.

Lot VIII. Peas alone.

Lots 2, 4, and 6 are being fed 0.5 pound of tankage (60 per cent) daily.

To obtain information in regard to mill feed as a hog feed, when fed in combination with barley, 16 spring shotes are being fed rolled barley and mill feed in various proportions, as follows:

Lot IX. Barley and mill feed, equal parts.

Lot X. Barley seven parts, mill feed one part.

Lot XI. Barley three parts, mill feed one part.

Lot XII. Barley five parts, mill feed three parts.

It is planned to publish these last two sets of data in bulletin form as soon as completed. It is also planned to publish at an early date the results of the lamb feeding work of 1917-18 on the relative value of pea and oat silage and corn silage.

Lamb and Steer Feeding.

It was recommended in the two last annual reports that work in

steer and lamb feeding be initiated on the Caldwell Substation, using such numbers as would enable feeders to rely upon the results of the work with considerable confidence. Funds have not been available for this work which, when once organized, could be made largely self-supporting and should be of immense practical value in aiding the proper development of the beef cattle and sheep industries of the State. Another much needed line of work that should be initiated at Caldwell is economical winter maintenance rations for beef cattle and sheep. This work is of equal importance to the finishing of steers and lambs for the market.

Livestock Management.

The breeding flock of sheep was maintained for the second year on pea and oat silage as the succulent part of the ration. The results were uniform success in lambing, no loss of ewes, and strong, thrifty lambs. The ewes milked especially well, as is evident from the rapid growth of the lambs. The ewes ate from two to four pounds of silage daily and had alfalfa hay in addition. A short time before lambing and after lambing, grain was added to the silage and hay ration.

The beef cattle herd was maintained for the third year on pea and oat silage as the succulent part of the ration. The results were uniformly good. The breeding cows and young cattle came out of the winter in strong, vigorous condition. All cows that calved during the fall and winter milked well as evidenced by the vigorous, thrifty condition of the calves.

BACTERIOLOGY

J. J. PUTNAM, *T. L. HILLS, PAUL EMERSON

During 1918 the department has labored under extreme difficulties. Early in the year Dr. T. L. Hills received a commission in the Army and left for France soon after his appointment. This vacancy was not filled until late in the summer when work was started anew on the Adams Fund projects. Before much could be accomplished, however, the demand for special courses for the members of the Students' Army Training Corps became so insistent that a large part of the investigational work had to be temporarily discontinued.

Commercial Preparation of Cultures.

The department began in 1914 to furnish pure cultures of legume bacteria to farmers at approximate cost. This practice was begun in the nature of an experiment, but the cultures have been built up to such a high state of efficiency, with the cost per acre kept to a minimum, that the demand for these materials has rapidly increased. This demand showed a remarkable increase by years up to 1918. The work has been made self sustaining. The actual number of acres sold since 1914 follows:

	Bean.	Clover.	Alfalfa.	Pea.	Vetch.	Total.
1915.....	.....	.....	.....	.....	.....	3139
1916.....	969	2183	2095	1265	24	6536
1917.....	4817	2250	2926	11272	.....	21265
1918.....	3150	1745	2585	7275	.....	14755

* Granted leave of absence for duration of the war.

While the summarized financial statement of the work shows that some profit has been made on the sale of the culture, the increased cost of materials and labor has reduced this profit to a bare margin of safety. A fund of not less than \$1500 should be retained in the department for the support of investigational and educational work.

The demands of the country for an increased acreage of grain and food crops has caused a very great demand for inoculation materials in the territory of northern and central Idaho. This is illustrated by the 1000 per cent increase of pea inoculum sold during 1917. This demand should be equally as great from the whole State, not only for peas, but for all the legumes.

Methods for improvement in culture production are being studied and efforts are being made to devise still better culture media on which to grow and distribute the organisms.

Influence of Various Woods on Bacterial Activity in the Soil.

Work on this project has been abandoned since Dr. Hills went into the service and this report covers only the results secured between December 31, 1917, and the date of his departure, together with suggestions for the furtherance of the work.

Studies were made of the ammonifying, nitrifying, and nitrogen fixing powers of the soils investigated together with the influence of varying amounts of different woods, added in the form of sawdust, on their biological activities. These studies were undertaken to determine, if possible, the reason why the cut and burned-over lands of the State are not as productive as they might be when first brought under cultivation, and have reached a point where an indication of a residual toxic effect has been recorded with certain woods and not with others, also that a corrective for this toxic effect may be found in the application of lime in the form of calcium carbonate.

The results secured indicate that progress has been made toward a more thoro understanding of the problems involved. The indications point to the fact that a number of factors are involved each of which must be determined, together with their influence on each other, before definite conclusions may be drawn. This will involve a large amount of preliminary laboratory work, supplemented with practical field tests in the localities affected.

Relation of Nitrates to Nodule Formation.

In the presence of nitrates, nodules are not produced on the roots of legumes to any extent and studies have been under way to determine whether this is due to a weakening of the infecting power of *B. radicum* as a result of growth in an environment containing an excess of nitrate, or whether the roots of the plants are made more resistant to the attack of the bacteria as a result of some action between the nitrate and the plant root. The problem was divided into two phases (1) The influence of nitrates on the infecting power of *B. radicum*, and (2) influence of nitrates on the plant root.

The first phase of this problem, using alfalfa and red clover as subject material, has been completed and shows that there is a decided difference in the influence of various concentrations of nitrate nitrogen

on the infecting (nodule producing) power of the organism. The concentration of the nitrate radicle apparently is the limiting factor as there seems to be little relationship between the concentration or kind of base and nodule formation. The nitrates of potassium, sodium, calcium and magnesium in amounts ranging from five up to and including one hundred milligrams of nitrogen as nitrate in one hundred cubic centimeters of the medium, had no appreciable influence in weakening the infecting power of the alfalfa organism, but the red clover organism was visibly affected.

The second phase of this problem is now being investigated. The results secured, owing to necessary corrections in technique and the difficulty of forcing plants to grow to maturity under laboratory conditions, are not conclusive enough to warrant an extended discussion. A practical method, however, has been developed whereby a leguminous plant may be induced to form two instead of the usual one main root. By an arrangement of flasks and connections, one of these roots may be grown in a water or sand solution of a known concentration, while the other may be grown under an entirely different concentration. It is hoped by the use of this device to secure some valuable information regarding nodule formation.

BOTANY

V. H. YOUNG

Little progress on botanical projects was made during the year. The work in plant physiology has been held in abeyance since 1917. Professor V. H. Young, who became head of the department of Botany of the University in September, will doubtless be associated with Chemistry in certain phases of the Apple Storage (Adams) project.

M. A. Willis, in charge of the station work in plant pathology, resigned in May, 1918. In the meantime the investigation of methods for control of *Rhizoctonia* of potatoes, a project in co-operation with Horticulture, has been carried on by C. C. Vincent of that Department. It is hoped to have an experienced pathologist in active charge of station work in plant pathology early in 1919.

CHEMISTRY

R. E. NEIDIG, C. L. VON ENDE, LULU E. VANCE

Two Bulletins Report Wheat Investigations.

During the year two projects, both dealing with the problem of improving the quality of wheat grown in Idaho, were completed and published in bulletin form. Bulletin No. 103, entitled Performance Records of Some Eastern Wheats in Idaho was published January, 1918. The work extend over a period of years and had for its object the determination of factors which control protein formation in the wheat kernel.

A summary of the work shows that the highest quality of milling wheat can be grown in many sections of this state. Turkey Red wheats, grown on the dry farm at Aberdeen, were fully equal to those grown in the hard wheat belt of Kansas and Nebraska. It was found on the Gooding

Substation, that the highest quality of Minnesota Bluestem and Glyndon Fife wheats were grown for a period of three years, with no indication at the end of that time of a deterioration in quality. The work indicated that hard spring wheat of the highest quality can be grown in south Idaho under irrigation if other conditions of growth are satisfactory. The hard wheats when grown at the Central Station Farm at Moscow were erratic in their protein content, during a period of eight years. The average, however, was not materially lower than that of the original seed.

Bulletin No. 109 entitled, *Irrigation and the Protein Content of Wheat* is now in the hands of the printer. The investigation was commenced in 1910 and was finished in 1916. The work clearly shows that the highest quality of hard spring wheat can be grown under irrigation if due attention is given to the supply of soil nitrates. The correlation of data leaves no doubt that a direct connection exists between soil nitrates and the protein content of wheat. It was also noted that variations in amounts of water caused some variation in the protein content of wheat.

Effects of Rotations.

In 1916 plans were made to determine the effect of crop rotation upon the protein content of wheat. An elaborate rotation experiment was planned and fully described in the annual report of this Station for 1916. The rotation series was planned to extend thru a period of 5 or 6 years. Two years' data on the spring varieties (Palouse Bluestem and Marquis) are at hand and analyses are being made on the third year's crop (1918). The 1918 results confirm those of the first two years, in the high protein content of the wheat. A similar rotation scheme, which included two winter varieties, Turkey Red and Gold Coin, was commenced in the fall of 1917. The wheat was harvested in 1918 and the samples are being analyzed. The wheats represent the first year of the rotation scheme and the protein content indicates that the full effect of supplying an abundance of soil nitrate has not been attained. It is possible that a higher protein content of wheat will be noted as the scheme of rotation becomes more developed.

Relations of Soil Nitrates to Protein Content of Wheat.

The results thus far secured from the rotation series indicate that the scheme of rotation probably brings about an abundance of soil nitrate. Previous work has indicated that the protein content of wheat is dependent upon the available soil nitrates. In order to definitely determine the relation of soil nitrates to protein in wheat, nitrate determinations are being made upon each series of wheat plats at different stages of growth. Determinations will also be made on a fallowed portion of the same plat. Samples will be taken at each foot depth for a total depth of six feet. With this data, the relationship of available soil nitrates and protein content of wheat can be definitely established.

Baking Experiments.

Composite samples of flour, secure from the spring and winter varieties of wheats grown each year on the rotation plats, are tested for baking qualities. At the conclusion of the rotation experiment, baking data will be available on each year's wheats. It will then be possible to note the effect of rotation on baking qualities of wheat.

The Acids of Silage.

Attention was called in last year's report to the results secured from a study of different crops and crop mixtures for silage. These results were published in the September issue, 1918, of the "Journal of Agricultural Research." In addition to the crops used in the first series, already reported, there are now available for examination, three new types of silage, namely: sunflower, sugar-beet tops and artichoke tops.

Sunflower silage has proven valuable for feeding purposes in some northwestern states. The large yield of green material per acre will greatly stimulate its general use, hence, it is essential that a thoro knowledge of the chemical changes be secured.

Sugar-beet tops are available in large quantities in the sugar beet district of southern Idaho. These tops, which were formerly considered more or less of a waste product, are now being preserved in the form of silage.

Artichoke tops are not a common crop. There is available, however, silage made from them, for examination at this time. It is the purpose of the department of Chemistry to make a chemical study of the acids formed in the three new silages during the coming year, since previous work has shown that the quality of acids produced is a criterion of good silage.

Digestion Coefficients of Sunflower and Beet-top Silage.

If it is possible to secure the necessary help, it is desired to co-operate with the Animal Husbandry Department and secure digestion coefficients on sunflower and beet-top silage.

Silage Proteins.

Study of the Hydrolytic products of proteins of different silages has been suspended indefinitely owing to the depletion of the staff and also to the fact that much preliminary work must be done before the Van Slyke method of determining amino acids can be applied directly to feeding stuffs.

Protein in Silage and Milk Production.

Last year's report indicated a line of work which would compare the efficiency of various silage proteins for milk production. This project was not undertaken on account of labor conditions due to the war.

Ewe's Milk.

This project has to do with the comparison of the quantity and composition of the milk of ewes of the various well-known breeds and a consideration of the relation of these factors to the growth of lambs. One phase of the work has been completed and will appear in a technical journal in the near future. It is possible that an additional project along the line of influence of milk on growth will be undertaken when conditions become normal in all departments concerned.

The Ash of Irrigated and Non-irrigated Fruits.

No work has been done on the quantitative analysis of the fruit ash samples. This will be undertaken during the coming year.

Apple Storage Project.

The general outline of this project is found in the Report for 1916.

The work is being continued with the same varieties of apples, (Jonathan, Wagener, Rome Beauty), as in former years, the material having been gathered from the University orchard. Unfortunately the war interfered very seriously with the progress during the season of 1917-18. During the summer, however, some preliminary preparations were carried thru intended to facilitate the tests on the material collected this fall, 1918.

Likewise, during the summer, Assistant Professor H. A. Holaday took up the problem of starch hydrolysis and diastase. He prepared, from green apples, a small quantity of pure starch to be used in the investigation. This work was abruptly interrupted by Mr. Holaday's call into the Food and Nutrition branch of the war service. The study of apple starch and its conversion is being continued.

This season's activities (1918-19) comprise experimental determinations to corroborate results obtained during 1916-17, and certain extensions of the experimental work. The former include osmotic pressure, electric conductance, exact acidity by conductance titration; the latter, desiccation and respiration loss, total solids, ash, hydrogen ion, starch hydrolysis and malic acid. Further, it is sought to correlate exact acidity and hydrogen ion concentration, since hydrogen ion presumably has an important bearing on the starch and sugar question.

There is research data at hand for a preliminary paper on "A Chemical and Physico-Chemical Study of the Apple." This paper is in preparation and may be published during the year.

DAIRYING

E. F. GOSS, * R. D. CANAN

Study of Organisms of Cottage Cheese.

Some progress has been made on the cottage cheese project. The confusion and delay incident to the moving of the department from its old quarters in Morrill Hall to the new dairy building prevented as much work as had been planned. The results thus far obtained have been with the higher storage temperature: namely, 50 degrees F. A progressive decrease in the total bacterial count of samples held at this temperature was obtained. Slight increases in total acidity and the acidity of the serum were noted. Curds, washed previous to salting for the purpose of lowering the acidity, increased in acidity very slowly. The results obtained in case of group of liquifying bacteria were variable. By packing in containers so as to exclude as much air as possible yeasts and moulds did not seem to be of importance in the deterioration of the cheese. During the coming year the work will be extended and the lower temperatures of the storage used. In view of the increased commercial manufacture of this product the work is timely and opens up an interesting and profitable field.

Barley and Corn Meal in Dairy Rations.

The project on the comparison of corn with barley in the ration for dairy cattle was organized during the past year, but was not completed

* Resigned September, 1918.

on account of difficulty in securing feeding stuffs and owing to the resignation of the dairy husbandman, who planned the work.

Records Made.

Among other work of the department should be mentioned the keeping of systematic production records of the herd of pure-bred Jerseys and Holsteins. The portion of the herd in milk consists of 18 to 20 animals. During the past year several animals have made excellent official seven-day records. Among them are Idaho Violet Posch Ormsby with a record of 593 pounds of milk and 27.55 pounds of butter, and Madison Anita with a record of 653.2 pounds of milk and 25.03 pounds of butter. Feed conditions have made it impossible to push this work as should be done in the future.

Advanced Registry Testing.

In the State as a whole there was a decrease in the advanced registry and registry of merit work supervised by this department. Seven herds were represented in this work during the year. Shortage of labor and feed are responsible for the decreased number of records. Indications point to more of this work during the coming year.

Other Activities.

During the past year about 200 samples of milk and cream sent in by creamerymen, farmers, and others were tested for fat, and the results duly reported.

The series of dairy products scoring contests held during 1917 were closed and a new series planned and carried out during the past year. This year the work was done in co-operation with the Extension Division. Part of the scoring was done at Moscow and part at Boise. About half of the creameries of the State submitted samples. That the reports on composition were made use of by at least a part of the creameries was evident by marked improvement in later samples and by letters of inquiry requesting information relative to the methods of composition control.

FARM CROPS

R. K. BONNETT, H. W. HULBERT

The experimental work in the department of Farm Crops is carried on with Hatch and Local Station funds. Altho only one more project has been added this year, yet the scope of the work has been greatly enlarged. Several new phases of work have been started and placed under the project to which nearest related.

Special War Activities.

In the spring of 1918 the Department inspected Idaho seed wheat for the United States Grain Corporation Committee on Seed Stocks. Samples representing a total of 29,695 bushels of seed wheat were inspected and only 2,033 bushels were rejected as being unfit for seed. As a majority of the spring wheat is seeded under irrigation in southern Idaho, about 66 per cent. of the seed inspected was of the common white spring class as represented by Dicklow, Bluestem and Sonora var-

ieties. About 44 per cent. of the seed stocks inspected were of the hard red spring class as represented by Marquis.

After the appointment of the Extension Agronomist, a large part of this work of seed stock inspection was turned over to him.

The correspondence of the department, consisting to a large extent of letters of inquiry from farmers over the State, has nearly doubled during the past year, much of it due, no doubt, to the agricultural impetus caused by the war.

Pure seeds of several crops, consisting of high yielding varieties of peas, wheat, oats, and barley were sent out to many farmers in varying quantities for spring planting. Seed of Grimm alfalfa was secured for a few growers who wished to secure a hardy, high yielding strain for hay production.

Experimental Work.

In some ways the season of 1917-18 was as unfavorable as the previous season. Altho there was sufficient moisture in the fall to enable fall plowing to be done, the light snow fall and lack of early spring rains did not give sufficient moisture for normal crop production. Winter grain came thru the winter in good condition. In the spring, however, the soil was badly frost cracked, which necessitated either the rolling or harrowing of the fall sown grain for best results.

Varietal Tests of Small Grains.

Turkey Red wheat, as in several previous years, demonstrated its high yielding ability. Kharkov, a variety similar to Turkey Red, and Red Russian also gave satisfactory yields. A plot of fall sown Marquis came thru the winter in fine condition and produced a good yield of grain of excellent quality. Red Rock, a variety introduced from the Michigan Station yielded fairly well. It cannot be recommended to replace the other varieties mentioned because it shatters very badly. In the nursery; several plant selections from hybrids looked very promising as far as yield and quality are concerned. Several strains of beardless Turkey gave good yields of high quality of grain.

Of the spring varieties, Jenkins Club, Palouse Bluestem, Early Baart and Marquis seemed most promising and all could be recommended for northern Idaho. Early Baart has performed very well in this section, producing grain of excellent quality, the chief objection to the variety among farmers, being the presence of the long stiff beards.

Among the varieties of winter barley tested, White Winter barley, a club variety, has yielded an average of 65.4 bushels since 1911. This exceeds the average yield of its nearest competitor by several bushels per acre. An increase plot of this variety was grown this season, and seventeen farmers were furnished enough seed at a nominal price to sow an acre. Another increase plot was seeded this fall so that more seed may be distributed next season. The best cultural methods for barley as shown by experimental work are; well prepared seed bed, six pecks of seed per acre, seeded in drills, medium early in the fall.

White Winter barely was also the high yielding spring variety. It has, however, had greater competition when spring seeded. Several other varieties have yielded well and are adapted to northern Idaho. Among

them are California Feed, White Smyrna, and Common Chili. As a general rule the six-row types of barley have given better yields here than the two-row types. The bearded varieties have outyielded the beardless types.

Variety tests of oats have demonstrated that neither very early nor very late maturing varieties yield best in northern Idaho. Those varieties which require a medium length of time to mature have produced the greatest yields. Among the varieties especially adapted to this section are Swedish Select, Banner, Danish Giant, Abundance, Colorado No. 37, and White Russian.

Winter rye, of which three varieties were grown, shows much promise as a crop for early spring pasture. It also yield a fair amount of grain. The leading variety, Petkuser, yielded a little over 35 bushels per acre in 1918 and attained a height at maturity of over six feet. Spring rye cannot be recommended for this section.

Forage Crops.

Some sixty different plots were seeded to pure cultures and mixtures of forage crops in the spring of 1918, but the stands secured were unsatisfactory, on account of a loose and poor physical condition of the soil. However, alfalfa seeded in rows gave a very fine stand and the plants made a good growth. From this season's work and that of previous years, seeding alfalfa in rows seems a commendable practice in dry sections. Among the other legumes that gave favorable results were red clover, sweet clover and alsike. These are important in either hay or pasture mixtures. Several grasses; namely, Brome Grass, Orchard Grass, Tall Meadow Oat, Perennial Rye Grass, Italian Rye and Slender wheat grass, gave the most promise of being of value in this section.

A few plants of the Annual White Sweet Clover were grown from seed secured from Professor H. D. Hughes of the Iowa Experiment Station. These were planted in the greenhouse, and later transplanted to the field where they made an excellent growth and the earliest blooms ripened seeds of good quality. Even tho this plant performed so favorably this season, it cannot replace the Biennial White Sweet Clover in hay or pasture mixtures.

Sudan grass, an annual hay plant, matured seed this season as well as produced a good yield of hay. This crop should be a successful one for either hay or pasture anywhere in Idaho. It should, however, be seeded in rows rather than drilled broadcast. A number of millet varieties gave fair yields, but not so great as the sudan grass. A few of the earlier varieties of sorghums were also grown, but none matured seed, and the majority were not far enough along to produce a good quality of coarse hay.

A number of different varieties of soy beans were grown, several different varieties producing mature seed. The earliest variety, Ogemaw, appears to be the best possibility for northern Idaho.

Various mixtures of peas and grain were grown for hay. These mixtures were less successful than in previous years. White Canada or White Colorado field peas are best adapted for use in hay mixtures. These mixed with oats at the rate of 100 pounds of peas to 50 pounds of oats have given the best yields.

Field Peas.

From experimental results at Moscow and those obtained from questionnaires sent to farmers throuth the State, field peas should be seeded early, in drills and at the rate of 85 to 120 pounds per acre, depending upon the size of the seed. The seed-bed should be fall plowed and well prepared in the spring. Harrowing after seeding is not desirable, but harrowing after the peas are up is advantageous. Large seed outyielded small seed of the same variety in nearly every case indicating that the grading of seed peas would be a profitable practice. This season the green aphid injured the crop to quite an extent, being especially bad on the later seedings, making another reason for early seeding.

The best varieties for seed production, because of their high yielding qualities and high market price, are Blue Bell, Blue Prussian and Alaska. For hogging off, White Canada, Bangalia or McAdoo (formerly Kaiser) are particularly desirable, as the seed is cheap and these varieties are also high yielders.

Field Beans.

Beans seeded at the rate of 30 pounds per acre in hills, dropping 6-8 seed to the hill, have given the best yields. Of the three varieties grown in the variety test, White Navy is the most promising. A number of other varieties were grown in the nursery, among them the Pinto bean, which does not appear to be adapted to this section of Idaho.

Corn Breeding.

From past season's variety tests with corn, Rustler's White Dent has proven to be the best corn for grain and for silage in northern Idaho. For this reason and because of the lack of land necessary for successfully carrying on variety testing, this variety was taken as the basis for corn breeding work.

About 75 different rows including checks were planted from individual ears. The corn was planted on May 22 and by October 1 had reached maturity. Seven rows yielded at the rate of over one hundred bushels per acre, one row making the exceptional yield of 123 bushels per acre. A number of rows yielded better than 90 bushels per acre. The work on the breeding up of this variety will be continued. Meanwhile seed will be distributed in small lots to a number of farmers in the State.

FORESTRY

F. G. MILLER

Forest By-products.

It was announced in the last annual report that the School of Forestry, in co-operation with the School of Mines, had started a series of experiments to determine the practicability of extracting oils from commercial woods of Idaho for use in ore flotation. The yield in gallons per cord, and the cost per gallon were determined for six leading species. Altho it is too early to draw final conclusions, the experiments thus far conducted are encouraging.

Tree Planting.

There has been published within the year Bulletin 105, entitled Tree—

What, Where, When, and How to Plant, prepared by C. H. Shattuck and I. W. Cook. This bulletin is based upon some eight years of careful experimentation to determine the forest trees best adapted for planting in the different sections of the State. It names the trees most suitable for woodlots, windbreaks, and ornamental purposes and detailed directions for the planting and care of trees are given.

The School also published last year Circular No. 5, Tested Forest Trees for Planting in Idaho. This circular is a price list of the forest and shade trees the School offers for sale. The revised edition of this circular for the season of 1919 is now ready for distribution and may be had on application. A large quantity of select stock is available and will be distributed to citizens of Idaho at approximate cost.

With the assistance of the Office of Foreign Seed and Plant Introduction a number of exotics were added to the arboretum. Experiments to determine the merits of fall planting vs. spring planting have been undertaken, and special attention has been given to the matter of wind-break planting in south Idaho.

Grazing Studies.

Owing to the intimate relation of forest management to the grazing industry, the School has underway a study of range improvement. In co-operation with the U. S. Forest Service a grazing reconnaissance has been made of the Caribou National Forest, resulting in a topographical map of the forest, and a complete grazing plan. A duplicate of the map is now in possession of the School as a loan from the Forest Service. This past year particular attention has been paid to the carrying power of other ranges for purposes of comparison.

Agricultural Possibilities of Logged-off Lands.

This investigation, only recently begun, contemplates a study of the logged-off lands of Idaho to determine what portion of them is chiefly valuable for agriculture, pasturage, or forestry. It includes both the private and state owned lands.

HORTICULTURE

C. C. VINCENT, L. E. LONGLEY

War Activities.

Since the ultimate object in a number of the horticultural projects is to secure increase in yields of various crops, it was not deemed necessary to change the original methods of solving the problems to meet war-time conditions. Realizing the importance of this phase of the work, the department has concentrated its efforts to the solution of those problems bearing directly upon production and conservation of food. The growing of vegetables to feed the vocational men taking special work at the University during the summer was also undertaken by the department. In addition, 6,000 pounds of prunes were evaporated, 150 gallons of kraut made, and 2,000 quarts of fruits and vegetables canned.

Bulletin on the Home Garden.

Two bulletins were published which give specific directions for in-

creasing the food supply, as well as conserving the same. Bulletin No. 106 entitled, The Home Garden in Idaho, discusses such subjects as location of the garden, classification of crops, hot beds and cold frames, irrigation, soil management, garden plans, preparation for planting, seeding, varieties to plant, seed selection, seed disinfection, control of insect pests and plant diseases.

The varieties recommended for Idaho are tabulated below:

Kind of Vegetable.	Varieties.
Asparagus	Conover's Colossal, Palmetto.
Beans	Stringless Green Pod, Black Wax.
Beets	Early Egyptian, Detroit Dark Red.
Brussels Sprouts	Long Island Improved.
Carrots	Early Scarlet Horn, Chatenay.
Cabbage	Early Jersey Wakefield, Danish Ball-head.
Celery	Golden Self Blanching, Giant Pascal.
Cauliflower	Dry Weather, Snowball.
Corn	Peep o'day, Early Cob Corey, Golden Bantam.
Cucumbers	White Spine, Boston Pickling.
Egg Plant	Black Beauty.
Kale	Dwarf Curled.
Kohl-Rabi	Early White and Purple Vienna.
Lettuce	Grand Rapids, Improved Hanson, New York.
Watermelons	Klondike, Kleckley's Sweet.
Cantaloupes	Rocky Ford.
Onions	Yellow Danvers, Red Wetherfield.
Parsnips	Guernsey, Hollow Crown.
Peas	Alaska, American Wonder, Dwarf Telephone.
Potatoes	(Early) Early Ohio, Early Rose, (Late) Nettetted Gem, Idaho Rural, Gold Coin.
Pumpkins	Small Sugar.
Parsley	Dark Moss Curled.
Peppers	Ruby King, Cayenne.
Radish	French Breakfast, White Icicle.
Spinach	Savoy Leaved.
Squash	(Summer) White Bush Scallop, Crooked Neck.
	(Winter) True Hubbard, Golden Hubbard.
Tomato	Sparks Earliana.
Turnips	White Flat Dutch, Purple Top Milan.

Bulletin 110.

Bulletin No. 110, Drying and Serving Fruits and Vegetables in the Home, contains data concerning sun-drying, cook-stove, hot-air, and steam evaporation. Tables are given for each method of drying, showing length of time to dry different products, weight of fresh material, and weight when dry.

The results of the cook-stove evaporator are shown in the following table:

Products.	Temperature in degrees F.	Time to dry hours.	Yield per ton in pounds.	Moisture
				Content Dry per cent.
Apples	130-150	6	400	24.0
Apricots	130-150	27	400	25.8
Cherries (sweet).....	130-150	22	480	23.3
Cherries (pie).....	130-150	22	380	29.0
Peaches	130-150	25-30	340	20.5
Pears	130-150	8	500	20.11
Plums	130-150	50-55	440	25.9
Prunes	130-150	60-70	660	28.1
Beans	130-140	10-15	220	21.0
Beets	130-140	7	360	18.0
Carrots	130-140	10	260	23.9
Corn	130-140	9	660	9.2
Potatoes	130-140	6	700	13.4
Pumpkins	130-140	4	120	22.1
Salsify	130-140	2	660	11.0
Turnips	130-140	10	160	22.8

Part 2 of this bulletin gives 37 recipes for preparing dried fruits and vegetables for the table. It is believed that with careful attention to details, the small evaporator can be made a very valuable adjunct to the orchard and garden.

Proposed Tomato Breeding Project.

The objects of the proposed work in tomato breeding are: (a) To secure an earlier variety. (b) To secure better canning varieties. (c) To obtain one or more varieties resistant to western tomato blight.

Radish Breeding.

During past winter, a portion of the greenhouse was utilized for radish breeding. A large number of crosses will be made between different varieties, which should furnish ample material for a study of mendelian characters. Such characteristics as form, size, color, and structure of roots and color of flowers will be considered.

Seed Production.

Since ideal conditions exist in Idaho for the growing of garden seeds commercially, a number of vegetable crops will be grown for seed production the coming year.

POULTRY HUSBANDRY

PREN MOORE

Flock Management.

There are two outstanding observations in flock management for this year. One is that leghorn hens lay much heavier when limited as to range than they do when allowed unlimited range. The other is that yards covered about six inches deep in cinders reduce to a minimum the possibility of disease.

Feeding for Egg Production.

The plan of the feeding experiment to determine the relation of

vegetable and animal proteins in egg production is fully indicated in the Director's report of 1916.

The reports for 1916 and 1917 show quite clearly that pens which were fed a vegetable protein ration produced not only less eggs but were kept at a loss. It was impossible to continue this experiment thruout the third year on account of difficulty in securing shorts. There was enough of the various feeds to last into August, and it was decided to undertake some work that would be of immediate benefit in solving war feeding problems.

Three Year Experiment Closed.

The third year of this experiment was started on November 1st as usual. The feeding plan was the same for the first four months, with relative results the same as in the first two years of the experiment. On March 1st sour milk was added to the ration. The milk was fed as a drink—not mixed with the feed. There were no other changes in the rations or conditions.

For the first 124 days, from November 1st to March 1st, Pen No. 4 laid 179 eggs at a value of \$5.96. Production cost was \$19.29 and loss \$13.33. For the following period of 167 days this same pen, with the addition of sour milk, laid 2559 eggs, an average of 102.36 eggs per hen. The value of the eggs was \$85.30. Production cost was \$29.99, profit \$55.31, and average profit per hen \$2.21. This experiment shows that vegetable proteins alone are not sufficient for profitable egg production. The results will appear soon in bulletin form.

In using war-time poultry rations, it was found that wheat could be eliminated from poultry rations without affecting egg production.

New Experiment Started.

A three-year feeding experiment is now under way to determine the relative value of the combination of sour milk and field peas as compared with other rations in egg production.

PURE SEED

R. J. LETH, P. A. WENGER

The annual report which follows is for the period, November 1, 1917-December 1, 1918, and was prepared by P. A. Wenger, Seed Analyst.

Seed Analysis.

The work of the laboratory has been carried on in accordance with the policy of previous years. Table No. 1 shows a decrease in Purity Tests. Table No. 2 shows an increase in Germination Tests.

	1917			1918		
	Number of Samples			Number of Samples		
	Analyzed	Passed	Condemned	Analyzed	Passed	Condemned
Alfalfa	826	449	377	752	396	356
Barley	5	3	2	2	1	1
Brome Grass.....	12	9	3	6	6	...
Buckwheat	2	2	...	...	...	...
Canadian Blue Grass	...	...	...	1	1	...
Clover—Alsike ...	124	99	25	71	48	23
Red	427	287	140	191	113	78
Sweet	22	22	...	8	8	...
White	108	83	25	50	30	20
Flax	1	1	...	...	...	...
Kaffir .....	...	...	...	1	1	...
Meadow Fescue...	16	8	8	8	7	1
Millett	5	5	...	3	3	...
Oats	7	5	2	2	...	2
Orchard Grass....	22	16	6	14	13	1
Pasture Mixture..	3	2	1	1	...	1
Rape	2	2	...	2	2	...
Redtop	9	8	1	10	10	...
Rye	1	...	1	...	...	...
Rye Grass—Italian	4	4	...	2	1	1
English	2	2	...	...	...	...
Perennial	3	3	...	3	2	1
Sorghum .....	...	...	...	3	3	...
Sudan Grass.....	8	8	...	2	2	...
Tall Meadow Oat	...	...	...	...	...	...
Grass	3	3	...	...	...	...
Timothy	92	74	18	48	36	12
Wheat	19	13	6	77	50	27
Winter Vetch....	...	...	...	1	1	...
Ky. Blue Grass...	23	21	2	32	25	7
Crimson Clover...	...	...	...	1	...	1
Total	1746	1129	617	1291	759	532

Germination Analyses.

	1917	1918	1917	1918
Alfalfa	30	63	Mangles	6
Beans-Var. ....	...	1	Meadow Fescue ...	1
Beets	4	...	Onion	7
Blue Grass	10	3	Oats	4
Brome Grass	2	1	Orchard Grass ...	1
Cabbage	2	...	Parsnip	5
Cane	1	...	Peas—sweet	1
Carrots	3	...	Peppercress	2
Clover—Alsike ...	1	7	Rape	1
Red	9	9	Redtop	1
Sweet	2	1	Spinach	2
White	1	5	Timothy	1
Corn	3	3	Tomato	2
Crested Dog's Tail..	1	...	Turnip	1
Dill	2	...	Wheat	7
Flax	1	...	Winter Vetch	1
Lettuce	3	5	Total	112
				198

Fees were collected for 1,024 tests at 25 cents each, totaling \$256.

Inspection.

Owing to lack of office force caused by the war, inspection could not be carried out as thoroly as in former years.

Field Work.

Field work was taken up mainly with the idea of getting acquainted with the different seed producing sections of the state. Seven counties were visited. In Camas County some special work was done in the determination of the purity of wheat. The results checked remarkably close by laboratory test of threshed samples of the wheat. Three fairs were visited and weed mounts exhibited which seemed to greatly interest farmers.

Financial Statement.

State Appropriation for biennium.....	\$10,000.00
Unexpended December 1, 1918.....	311.00
Amount disbursed to December 1, 1918.....	\$ 9,689.00

Disbursements.

By Projects.		By Expense Classification.	
Name.	Amount.	Name.	Amount.
Administration	\$2,463.23	Salaries	\$2,528.29
Analytical and Field Work....	6,100.86	Labor	356.89
Inspection	1,124.91	Publications	8.75
		Stationery and Small Printing..	180.76
		Postage, Tel. and Tel. Freight	
		and Express	378.20
		Supplies	53.68
		Library	7.45
		Tools, Machinery, and Appli-	
		ances	173.25
		Furniture and Equipment.....	257.88
		Scientific Apparatus and Speci-	
		mens	631.06
		Traveling Expenses	2,041.92
		Contingent	70.87
Total	\$9,689.00	Total	\$ 9,689.00

New equipment was added bringing the laboratory up to date and making it possible to do more accurate and rapid work. Extensive equipment was also purchased for the grain inspector's laboratory.

SOIL TECHNOLOGY

P. P. PETERSON, E. B. HITCHCOCK

Rotation and Fertilizer Experiments.

In the plot experiments at Moscow, data of value have been obtained especially on the use of manure. The average yield of wheat upon the plots of various rotations receiving no manure or other fertilizer was 17.7 bushels per acre, whereas that on the plots receiving stable manure was 21.5 bushels. The average yield of wheat in rotation, continuous wheat, was 14 bushels per acre where no manure had been added since the rotation was started and 21.2 bushels where manure has been added, an increase of 7.2 bushels per acre for the use of manure every third year.

In the last three years the average yield per acre of wheat on the unmanured plots of continuous wheat is 15.7 bushels. That on the manured plots of continuous wheat is 19.2 bushels. The following table gives the detailed data.

Yields of Wheat on Unmanured Plots. (Bushels per acre)

Year.	Plot B. 2	Plot D. 8	Plot E. 10
1916.....	23.1	24.6	36.5
1917.....	5.8	10.7	8.8
1918.....	12.3	15.1	14.5
Total 3 yr.....	41.2	50.4	59.8

Average of three plots for three years, 16.8.

Yields of Wheat on Manured Plots. (Bushels per Acre)

Year.	Plot B. 3	Plot D. 9	Plot E. 11
1916.....	24.9	32.6	36.7
1917.....	6.4	11.2	17.4
1918.....	17.4	24.8	21.4
Total 3 yrs.....	48.7	68.6	75.5

Average of three plots for three years, 19.2.

This data is for one rotation only. It demonstrates, however, that manure is of real value upon the Palouse silt loam. Data on other rotations is equally conclusive and reliable. It is proposed, therefore, to make a detailed report at a later date. The rest of the data will be given at that time.

In the rotation and fertilizer experiments on the Sandpoint Substation a yield of two and one-half tons of clover and timothy hay was obtained in the rotation, wheat, oats, clover and timothy two years. A yield of 12.6 bushels of wheat was given by land broken from clover and timothy sod as compared with a yield of 8.5 bushels from plots otherwise similarly treated. These facts bear out our contention that land broken from the forest should first be seeded to clover or clover and timothy in order to get the greatest possible immediate returns to build up the soil for future crops.

Potatoes seem to be a good crop for the type of soil represented at Sandpoint. This year's crop produced one hundred and two bushels per acre, with the quality of the potatoes, as heretofore, of the very highest.

Fertilizer Distribution to Farmers.

This year the effect of nitrogenous commercial fertilizer upon beans was studied. Owing to the fact that cut worms damaged the bean crop badly, the effect of the fertilizer was not always apparent. Mr. Eric Oller of Troy, who had little cut-worm damage, carried out his experiment very faithfully and reports an increase of 189 pounds of beans per acre for the use of 100 pounds of nitrate of soda. Mr. A. N. Rognstad of Kendrick, also did very careful work and obtained valuable results. He used packing plant by-products furnished by the Union Stock Yards of North Portland, Oregon. The nitrate of soda and sulphate of ammonia were furnished by the Chilean Nitrate Committee and the Barrett Company, respectively.

Duty of Water.

This experiment was conducted using wheat the past season, the first series being sown in October, 1917, the second in April, 1918, and the third in May, 1918. At Moscow data of considerable value have been obtained. This year showed a much higher moisture requirement than

was expected. At Idaho Falls data was obtained, but at Jerome no data were secured this year.

The table below gives the duty of water found at Moscow and Idaho Falls.

Duty of Water at Moscow and Idaho Falls (Wheat)			
	Fall Series	April Series	May Series.
Moscow	340	365	420
Idaho Falls .....	...	279	211

Alkali Investigations.

This work has been carried out as well as conditions permit. The greenhouse space necessary for its continuance during the winter has not been available and only summer crops have been grown. These consist of wheat, oats, and barley in the three-gallon jars and alfalfa in the large potometer. Using these crops valuable data have been collected.

The orchard part of the project was planted this season. It will have to be replanted entirely next season, however, because of damage by rabbits which could not be kept out by a fence around the whole orchard. Each tree must be provided with a screen. This will be done next season.

Soil Survey.

During the past summer the western part of Bannock County was surveyed and the soils classified and mapped. The intention was to cover the entire county with the survey, but this could not be done because of the lack of funds to finance two parties in the field. At the end of the season it appeared certain that the Bureau of Soils Cooperator, Mr. H. G. Lewis, would be called to military service before another season. The report and maps were, therefore, prepared for publication and in due time will come from the Government printing office.

A subsequent report of chemical composition should be prepared by this department. The soil samples for this work have been collected, but because of the lack of financial support, the work cannot be undertaken at this time.

ZOOLOGY AND ENTOMOLOGY

J. E. WODSEDALEK, R. H. SMITH

Clover Aphis and Control Methods.

So disastrous has been the experience of Idaho clover seed growers with the clover aphis since 1913, particularly in 1916, when the loss ran into hundreds of thousands of dollars, that during the past two years the acreage of red clover grown for seed has been reduced nearly 80 per cent and alsike over 70 per cent. That this great reduction in acreage is due chiefly to the ravages of the clover aphis and not to war conditions which put a premium on cultivated crops, is proved by the testimony of hundreds of farmers in the clover-growing districts.

While other insect pests are causing enormous annual losses to the farmers and fruit growers of Idaho, with the limited budget of \$4,000.00 appropriated by the 1917 legislature, it seemed wise to concentrate the efforts on the most serious pest in the state at that time, namely, the clover aphis.

In May, 1917, field headquarters were established at Twin Falls for the purpose of trying out thoroly control methods and for completing a study of certain doubtful points in the life history and behavior of this pest. The growing season of 1917, however, proved to be an abnormal one as regards weather conditions and a poor one for the pest, and little progress was made, as is indicated in the last annual report. The year 1918, however, was a fruitful one, and the studies which were started early in the spring and continued thruout the summer and fall yielded valuable results. The early discovery of the fact that the pests in various stages of development survive the winter in enormous numbers in the clover crowns where they are protected by dead foliage paved the way to a definite working program. Sufficient progress was made during the year to warrant the publication of a preliminary report. Some phases of the investigation are still under study and experiment, and it is hoped that a final and detailed account may be published before the close of another year.

Life History of the Clover Aphis.

With the exception of a few weeks in October and Novemer, every clover aphid is an "agamic" female that gives birth to living young. Each young aphid begins reproducing when it is six or seven days old. The average reproductive period is about nineteen days, during which time an average of five young are born daily. The average length of life is fifty-one days and the average number of young produced by one female is eighty-one.

With the approach of frosty weather in October and November, there appear certain winged forms called "fall migrants" which fly to apple and other fruit trees. Here they feed on the leaves and give birth to young, some of which are true females and some true males. The male and female individuals mate and each female lays two tiny eggs on the young twigs. The eggs hatch early in spring and the young feed and multiply on the leaves for a period of time. Then winged forms appear which fly back to clover.

Only a small per cent of the aphids go to fruit trees in the fall. The remainder continue to feed and multiply on the clover, many of them surviving the winter.

Control Methods.

The results of the clover aphis study, together with a discussion of control measures that have been found most successful, are found in Bulletin No. 112, entitled A Preliminary Report on Clover Aphis and Methods for its Control. This publication gives detailed information regarding the following methods of control:

1. Destroying of hibernating places by close grazing, using sheep on clover fields, orchards, ditch banks, and waste places.
2. Late spring grazing by sheep of both red and alsike clover.
3. Flooding of aphis infected clover fields with irrigation water.
4. Spraying for destruction of aphis on alsike clover.

Other Work.

The need of other work in entomology has been emphasized in the

last report. This need still exists, and in fact has been augmented by the appearance of another serious pest—the spring grain aphid.

Additional Cytological Studies of the Reproductive Cells of the Mule.

Detailed study of the tissue from an additional male mule has led to a complete corroboration of the results previously obtained and published (Woodsdalek—Causes of Sterility in the Mule—Biol. Bull., Vol. XXX, No. 1, January, 1916). The process of spermatogenesis is incomplete and no spermatozoa are formed. The cells disintegrate in the primary spermatocyte stage of development. The tissue of a female mule has not as yet been obtained.

Cytological Studies of the Reproductive Cells of Cattle.

Several hundred cytological slides of this tissue have been made and the studies on spermatogenesis are completed and ready for publication. It was found that in the bull, as in the pig (Woodsdalek, '13) and in the horse (Woodsdalek, '14) two types of spermatozoa are produced; the one type, at the time of fertilization, determines maleness, and the other type determines femaleness. Thirty-seven chromosomes are present in the spermatogonia; of these thirty-six are the ordinary chromosomes and one is the accessory chromosome or the sex-determining element. The primary spermatocyte division is the reduction division; eighteen chromosomes go over to one pole, and eighteen plus the accessory to the other, thus giving rise to two different secondary spermatocytes which eventually develop into two different types of spermatozoa.

Sex-determination with its attendant problems, particularly that of sex-linked inheritance, has always been a subject of great interest to practical animal breeders; and the art of breeding developed several rules by which the ratio might be shifted in various ways to the advantage of the breeder. But all of these rules have been founded upon inadequate evidence and unsound reasoning. This research shows that sex in cattle, as in swine and horses, is a matter of inheritance, and for the present, at least, beyond the control of the breeder. It is hoped that sex control experiments based on these cytological results may be undertaken later.

Cytological Studies of the Reproductive Cells of Sheep.

Many slides have been made of this tissue and considerable time has been devoted to their study. No definite statements, however, can be divulged at this time.

ABERDEEN SUBSTATION

L. C. AICHER, Superintendent.

Progress Made.

The investigations on the Aberdeen Station have been continued as previously reported, with but little change in detail. War emergency work and the curtailment in the supply of labor caused a few minor changes to be made in the conduct of some of the experiments. Much valuable information on the production of wheat, oats, barley, field peas, and potatoes under irrigation, accumulated during the past six years of investigation, is now available for publication. A bulletin

on the production of wheat, oats, and barley under irrigation in southern Idaho is now being prepared.

Dry Farming Investigations.

This has been the driest year for crop production on the dry land since the establishment of this Station. The precipitation during the growing season this year was 3.37 inches as compared to 4.16, the annual average, and 5.16 inches received in 1917. One and thirty-five one-hundredths of the 3.37 inches fell after the middle of July, when the winter wheat had already made its growth and was ripening.

The winter wheats survived the winter in good condition but growth was retarded in early spring by cold weather. This cool weather, however, caused the crops to stool well. The crops showed need for moisture early in May. Rain the latter part of May helped the wheat considerably and, if additional rains had followed at opportune times, excellent crops would have been assured. However, the dry land crops began burning badly about the middle of June, causing short heading. The continued drought brought on premature ripening with considerable shriveling of grain.

Wheats.—Variety tests with winter and spring wheats were continued, and, this season for the first time, the spring wheats outyielded the fall sown varieties, due largely to the distribution of the rainfall favorable to spring wheat. However, the average yields for the past six seasons are in favor of the winter varieties.

Average Yields of Wheats on Dry-land Farm 1913-18

Winter Wheats.	Bushels per acre.	Spring Wheats.	Bushels per acre.
Alberta Red	18.8	Early Baart	12.0
Ghirka	18.6	Bluestem	12.0
Theiss	18.1	Little Chit	10.0
		Marquis	9.6
		Dicklow	8.5
		Kubanka Durum	6.6

Spring Grains.—In the variety tests with spring grains the oats averaged 7.1 bushels. The sixty-day oats ranked first with an average yield of 20.4 bushels. The Beldi and Smyrna barleys lead in the variety tests with an average annual yield of 12.9 bushels and 14.1 bushels respectively.

Field Peas.—The following table shows the average annual yield of field peas for the years 1913-18 inclusive.

Variety.	Bushels. per acre.	Variety.	Bushels. per acre.
McAdoo (former Kaiser).....	8.1	Solo	6.9
Grey Winter	8.1	Bangalia	6.7
White Canada	7.7	Cossack	6.7
Amraoti	7.5		

Flax has been tested for a number of years with one complete failure and very small average yields. The average yield for all varieties this year was 5.6 bushels to the acre, and the highest yield obtained was 7.8 bushels per acre from C. I. No. 30.

Potatoes.—Potatoes produced well on the dry lands this season, due in part to seepage of water from a nearby irrigation lateral.

The average annual yields of potatoes for three consecutive seasons are shown in the accompanying table.

Variety.	Bushels. per acre.	Variety.	Bushels per acre.
Idaho Rural	224.5	Early Rose	188.3
Green Mountain	208.5	Early Six Weeks	160.8
Irish Cobbler	202.7		

In the seed transposition test with potatoes the seed grown on irrigated land produced an increase of 8.9 bushels of potatoes to the acre over seed grown the previous season on dry land. In the five-year test, however, with yields above 200 bushels in some seasons, this increase is negligible, indicating that the supposed superiority does not exist.

In the method of seeding tests, the results indicate that wheat should be drilled, the depth depending on the soil and seasonal conditions. Early planting is best if the rain comes fairly early, and in the country surrounding Aberdeen wheat should not be planted after October 1st. The best rate of seeding is 3 to 3½ pecks to the acre, depending on the time of seeding.

Cultural Tests and Rotations.—The cultivation of winter wheat has not proven profitable at this station insofar as increased yields are concerned. Lack of uniformity in the soil is partly responsible for these results, at least for the lack of consistent results.

In the rotation experiments, summer fallowed ground yielded an average of 6.2 bushels of wheat to the acre, while the average of the winter wheat plots was 4.4 bushels to the acre. The plowing under of green manure has not proved profitable. Wheat following peas has given the best results of any rotation, but if used continuously without fallow, both crops will soon be reduced in yield to a point where they will be unprofitable.

The general conditions on the dry farm, surrounded as it is on three sides with irrigation laterals, and the lack of uniformity of the soil and of a sufficient area for replication of plats, makes it necessary to abandon the dry-land work at the station at this time. This land will be used for irrigation experiments and another farm is to be obtained as soon as possible for the dry land work.

Work on the Irrigated Farm.

The season of 1918 was quite favorable for the irrigated farm. With the exception of the cereals, all crops did well. The peas and potatoes produced the highest yield ever recorded at this Station. One variety of peas yielded over 63 bushels to the acre and the lowest yield, from the Bangalia variety was 40.8 bushels to the acre. Garden peas, flax, Grimm alfalfa, and the clovers did well. Mangels and sugar beets were grown for seed and indicate the opportunity for southern Idaho as a seed producing center. Every effort will be made to encourage the industry.

Small Grains.—In the variety tests with small grains the following average yields are shown for the seasons 1913-18 inclusive.

Spring Wheat.	Bushels per acre.	Oats.	Bushels per acre.
Dicklow	51.2	Silvermine	112.5
Bluestem	46.1	Early Mountain	114.8
Defiance	45.4	Golden Rain	115.1
Marquis	41.6	Swedish Select	106.1
Early Baart	39.1		

	Bushels per acre.
Barley.	
Trebi	87.4
Beldi	79.7
Hanuchen	79.2
Sandrel	79.2
Han River	76.5
Peruvian	75.1
Smyrna	73.1

In the three-year trials with flax under irrigation the Smyrna variety averaged 26.6 bushels to the acre, while the yield this season was only 21.7 bushels as compared with the Russian variety which yielded 27.7 bushels to the acre.

Several hundred cereals were grown in nursery plots as in former years to determine their value for southern Idaho.

Peas.—There were 19 varieties of field peas, 15 of sugar peas, and 19 varieties of field and garden beans grown this season. The field peas averaged 55 bushels to the acre while the garden varieties averaged 48.6 bushels. The World's Prize and Wellwood, a blue and a white variety respectively, have produced the highest yields in the five-year test. The Welwood variety has been increased and seed is now available for distribution. The larger vined, late maturing, garden peas produce the best yields under irrigation in southern Idaho.

Alfalfa and Clover Seed.—The Grimm alfalfa seed crop was very good this year, yielding at the rate of five bushels to the acre on all plots. The Grimm has proved itself to be well adapted to this section of Idaho because of its extreme hardiness and ability to withstand winter killing.

Alsike clover averaged 2.5 bushels and Red Clover 3.0 bushels to the acre.

Potatoes.—In the potato variety tests the three highest yielding varieties are Idaho Rural, Green Mountain and Irish Cobbler, averaging for the past five seasons 400.0, 397.4, and 352.3 bushels per acre respectively.

No increase in yield has resulted in the potato seed transposition tests when the average annual yields are considered for the past six years. The results from experiments on the time of irrigation, method of cutting, distance of rows, and size of seed piece tests coincide with the results published in the report last year.

Seed Cleaning and Marketing.

Large quantities of alfalfa seed, wheat, barley, and other seeds have been cleaned in the Station cleaning plant. Lack of storage capacity is a handicap in handling the great volume of cleaning business which has developed as a result of the efforts to have the farmers market their seed in better condition, thereby obtaining a higher price. The seed cleaning work causes considerable extra labor and takes more or less of the

time of the Superintendent. It is felt, however, that the results more than justify the effort put forth. The market for Grimm alfalfa is constantly enlarging, and new fields of Grimm for seed production are constantly being planted in the endeavor to supply the demand.

Extension Service.

A few trips were made into Twin Falls, Minidoka, Cassia, Blaine, and Power Counties and into the upper Snake River Country, including Idaho Falls, Rexburg, St. Anthony, Ashton, Felt, and Driggs. These trips were made in the interests of better farming, and most of them at the requests of county agents through the Extension Service or at the request of the Experiment Station. Lectures in Minidoka County were on production methods in the handling of clover seed, alfalfa seed, peas, sugar beets and small grains, on dry farming, and on increased production and conservation.

In the immediate vicinity of the Station, war work directly affecting increased production occupied considerable time of the Superintendent. The work consisted of seed selection, demonstration of methods for treating grain for smut control, frequent trips to near at hand farms to inspect fields, suggestions regarding handling of irrigation water and the treatment of pests and diseases, and trips to threshing machines to adjust same to prevent cracking of grain and blowing of it into the straw. The carload of Dicklow seed wheat distributed for this year's seeding on irrigated land increased the yield of wheat very greatly in this section, and a cleaner and better lot of wheat has been brought to the elevators as a result. The Dicklow will be planted almost exclusively next year as a result of this year's experience.

Other Activities.

The Superintendent was community chairman for the Bingham County Farm Bureau and obtained 75 members in the first drive. As chairman of the finance committee of the Red Cross he gave considerable time to organization work and collection of funds. The boys and girls club work called for time and attention. The Superintendent served as judge of farm crops exhibits at the Minidoka County Fair at Rupert, at the Southern Idaho Fair at Filer and at the State Fair at Boise.

CALDWELL SUBSTATION

C. M. EKLOF, Superintendent.

The work of the Station for 1918 has been largely a continuance of the program of former years.

Variety Testing.

Certain of the more promising varieties of wheat, oats, barley and potatoes have been grown for the purpose of determining those best adapted to the region in which the Station is located. The farmer is always interested in yields and a promise of two to three bushels larger returns per acre may cause a new variety to be given wide preference.

Unevenness of soil on the farm at Caldwell makes necessary the abandonment of plans for carrying on variety tests. Variations of soil

frequently affect a portion of a field plot so that uniform and dependable results cannot be had. During the past year the plots were one-fortieth of an acre and were duplicated.

The discontinuance of variety testing does not mean that there is not a big field of work for the Station. The production of field crops and the use of the farm for testing methods of diversification of farm practice and for determining the extent to which various kinds of livestock can be utilized in the agriculture of southwestern Idaho offer ample opportunity for important investigations.

Pork Production.

Small fields of wheat and of corn were harvested by the hogging-off method. The field of wheat was divided into two equal parts and one-half threshed to secure data on yield. The following table gives the results of the threshing and the hogging-off trials:

Hogging-off Crops.

	Wheat Threshed.	Wheat Hogged-off.	Corn Hogged-off.
Area of field in acres.....	.744	.744	.704
Yield per acre in bushels.....	12.70	.....	.....
Stand	Poor	Poor	Fair
Weight in pounds of 14 hogs turned in.....	.....	762	949
Time on field in days.....	.....	24	21
Weight in pounds of 14 hogs turned out..	.....	949	1352
Gain in pounds.....	.....	187	403
Pounds of pork produced per acre.....	.....	252	572
Value of pork per acre, hogs at 15c.....	.....	\$37.80	\$85.86

The pork value of the wheat, taking the yield from the portion threshed, was \$2.97 per bushel. This was a satisfactory price, since the harvesting and threshing costs were eliminated. No information was obtained regarding yield per acre of the corn. The hogged-off corn gave \$85.86 worth of pork per acre, a highly satisfactory cash return.

Hogging-off of crops saves the time and expense of harvesting and storing crops. Furthermore, this method results in soil improvement. The disadvantage is in labor and expense of fencing. Woven wire should be used for enclosing hogging-off crops.

Dairy Herd Improvement.

The Station dairy herd, made up largely of grade Holstein-Friesians, was purchased in 1915. During the past year the low-yielding cows were eliminated and three new cows added. The average milk yield of the present herd is above 7,500 pounds. The test is quite uniform, running 3.3 per cent. to 3.5 per cent. The lowest producing cow yields annually approximately 5,000 pounds of milk, testing 3.3 per cent. butter fat. The highest producing cow yields 11,000 pounds of milk annually testing 3.3 per cent. butter fat.

The first herd bull, Duke Clothilde Dekol Korndyke 149427, was found to be unsatisfactory. His daughters have fallen below their dams in milk yield. The bull now in use, Prince Pietertje Albert 205349, comes of heavy producing ancestry and his influence should be beneficial to the herd.

A total of four purebred Holsteins are in the herd. In addition to

the herd bull there are two pure bred cows and a pure bred heifer calf. It is hoped to add a few more especially good grade cows, making room for them by disposing of less productive cows.

Crop Production.

Approximately one hundred acres have been devoted to the production of such crops as alfalfa, barley, corn, and pasture. Something like five acres have been used in growing feed for hogs and in variety tests of cereals. Thirty acres are in alfalfa. Three full crops of alfalfa were secured the past season with an average yield of $3\frac{1}{2}$ tons per acre. This is a good yield since frequent "slick spots" are found on the land now in alfalfa.

Approximately forty acres were seeded to Sandrei barley. With the exception of 5 acres this land had never been in alfalfa or other legumes and the barley yield was low, 15.8 bushels per acre.

Silvermine corn was used as a silage producing variety. The total silage yield was 65 tons on seven acres, or an average of 9.28 tons per acre. The silage provides succulent feed for the cows in milk after the pasture season, which ends about December 1st.

Though the pastures are on a portion of the farm that has shallow soil and irregular slopes not suited for producing crops other than grass, the results from the pasture have been highly satisfactory. Twenty-five acres are used for growing pasture for horses and cattle. The predominant grass is blue grass. In order to get best results in midsummer it has been found desirable to irrigate the pasture lands once per week.

Soil Management.

The soil of the Caldwell Substation is shallow, averaging from one to three feet, and is underlaid with a hard layer impervious to water. The slope is heavy, requiring care in laying out and in running water through corrugations. On account of lack in soil depth, frequent irrigations are required. The "slick spots" require special cultural methods and particular care in irrigation.

The correction needed is humus. The whole plan of handling the farm, including the system of rotations, must be modified to meet this situation. The rotation advised should provide for at least one year in meadow for each year that a cereal crop is taken off the land. The following rotations are suggested as suited to the particular region:

No. 1		No. 2	
Alfalfa	3 years	Alfalfa	4 years
Corn	1 year	Corn	1 year
Grain	1 year	Wheat	1 year
		Barley or oats.....	1 year
No. 3			
	Wheat (seeded to clover).....	1 year	
	Clover	1 year	

Improvements.

A number of improvements were found necessary during the year. Some old sheds were torn down and from the lumber thus obtained there was constructed a machine shed 18x60. This provided additional storage

for machinery and improved the appearance of the farm. The buildings, including the farm residence, were painted. The pumping plant was lowered into a cellar to protect it from freezing, and a milk testing and separating room constructed over the cellar. New fence construction and repairs of old fencing totaled two miles. Forty acres of sage brush land have been reclaimed during the past two years.

In the spring a new four-room house was built for the use of the dairyman. Because of the distance from the Station Farm to Caldwell, $3\frac{1}{2}$ miles, it is necessary to provide all help with lodging and board on the farm.

Of the half section included in the farm, 275 acres are irrigable. One hundred fifty-five acres are cleared and in crop or ready for cultivation. An important step has been taken toward making the entire farm productive by leasing 80 acres of sagebrush to Mr. H. H. Brewer, the land to be handled for four years without cost to the University and returned at the end of that time properly leveled and seeded to alfalfa.

Recommendations.

For a time at least, agronomic experiment work should be discontinued. The farm can be made of very great value to a considerable region by carrying on work of three kinds: Soil improvement, feeding investigations, and production of high grade and pure bred livestock. Rotation of crops and use of animal manure will do much toward soil improvement. Feeding tests organized in a comprehensive way will furnish a market for surplus hay grown on the farm and ample manure for soil upbuilding, and will no doubt yield data of great value to prospective feeders. Livestock production is one of the important sources of income of the farmer, and the University Substation should keep various kinds of livestock, and, if possible, lead in livestock improvement.

HIGH LAND EXPERIMENT STATION

W. A. Moss, Superintendent.

There was considerable delay in securing a suitable location for the High Land Experiment Station authorized by the State Legislature in 1917. The initial appropriation of \$3500 was contingent upon a like amount to be provided by county or other sources. By action of the Board of County Commissioners of Teton County \$3,500 was guaranteed to meet the terms of the legislative enactment.

A number of proposed sites were examined by one or more members of the committee charged with authority to select lands for the station. This committee consisted of Mr. William Healy, member of the State Board of Education and Board of Regents of the University of Idaho, Dr. E. A. Bryan, Commissioner of Education, and the Director of the Agricultural Experiment Station. The land finally selected consists of two tracts: one hundred sixty acres of dry farming land located approximately four miles west of the town and postoffice of Felt, secured and to be held under state lease, and forty acres of irrigated land located within three-quarters of a mile of Felt, one-half of which has been purchased and the other half leased for a term of years. Both tracts are

within Teton County.

The irrigated land will be used for experiments in crop production under conditions prevailing at an altitude of above six thousand feet and will serve as headquarters from which both farms will be operated. This land is now in meadow. The one hundred sixty acre dry farm is under cultivation with exception of a small acreage and the improvements consist of log house, sheds, granary, and cistern. The entire tract will be used for dry farming investigations.

Mr. W. A. Moss, a graduate of the Kansas State Agricultural College, has been appointed Superintendent. A cottage for superintendent's residence is nearing completion on the forty-acre farm. Other improvements such as well, barn, seed house and fencing will be undertaken at any early date.

The experimental work planned for this station has to do with varieties of grains and forage crops best adapted to the region, cultural methods, rates and time of seeding and other problems of a similar nature. The station lands are typical of a vast area suitable for agricultural purposes to be found in eastern Idaho. The opportunity for carrying on interesting and highly valuable investigations at Felt has been called to the attention of the Office of Cereal Investigations of the United States Department of Agriculture with the purpose of inviting Federal participation in the work of the High Land Experiment Station.

JEROME SUBSTATION

G. W. DEWEY, Superintendent.

Station activities for the past year have consisted of potato cultural investigations, and the growing of six varieties of canning peas and several selections of White Pea beans.

Irrigation Studies of Potatoes.

The tests in irrigation, carried on with Netted Gem and Idaho Rural potatoes, consisted of various treatments as follows: irrigation before plowing, irrigated up, first irrigation withheld, infrequent irrigation (four irrigations during season), frequent irrigation (every seven days), and ordinary irrigation (every ten days). The results obtained were in favor of irrigation before plowing followed by irrigating once every ten days.

Greening of Seed.

The investigations with greened and ungreened seed were with Netted Gems and Idaho Rurals. Owing to the unusually long growing season, the results were indecisive, the Netted Gem giving a slight increase for the greened seed and the Idaho Rural a slight increase for the ungreened seed.

Introducing Foreign Stock.

This line of investigation was for the purpose of determining the effects of a foliage disease present in the station stock. The experiments were with Netted Gems and Idaho Rurals secured from Twin Falls in 1918, Netted Gems and Idaho Rurals secured from Twin Falls in 1917 and grown with station stock that year, and Netted Gems and Idaho

Rurals of station stock. The results showed that the foliage disease had spread to the disease-free stock secured from Twin Falls in 1917.

Maturity of Seed.

Unmatured seed of Idaho Rural and Netted Gem potatoes was secured in 1917 by planting on July 1st. As in previous years there was a striking difference in yields in favor of the unmatured seed.

Seedlings.

Ten new seedlings were grown during the past year, two of which showed remarkable possibilities in point of yield and desirable type of tubers.

A number of selected hills from disease-free fields were grown with pleasing results. The station stock has been replaced with new strains.

Canning Peas.

The six varieties of canning peas consisted of Perfection, Horsford, Admiral, Little Gem, Gregory's Surprise and Alaska. The first four, which were late varieties, produced yields from 30 to 40 bushels per acre.

Beans.

The bean investigations consisted of the growing of nine selections of White Pea beans on an area of three acres. The yields promise to be very high.

SANDPOINT SUBSTATION

F. H. LAFRENZ, Superintendent.

Season Unfavorable.

The farmers of this locality experienced a cold, late spring, and by the time the weather became settled there was not enough time to allow for a proper growth before the hot months. Though the winter and spring months were not severe, and the ground was not covered with snow, the ground froze deeper than usual, causing heaving. This resulted in heavy loss of fall seeded grain and destruction of pasture and meadow crops.

Some Crops Yield Well.

Meadow crops and pasture mixtures seeded on the Station Farm in the spring were not successful. Oat hay made a light crop, clover hay produced $\frac{3}{4}$ ton first cutting and $1\frac{3}{4}$ tons second cutting. Varietal work with Clydesdale, Kerches, Banner, Swedish Select, Abundance, Big Four, Early Mountain, and Iowa No. 103 oats returned little more than the seed planted. Japanese buckwheat yielded at the rate of 24.8 bu. per acre; Silver-hull buckwheat at the rate of 13.2 bu. per acre; Russett potatoes, 181 sacks per acre; Rural New Yorker potatoes, 148 sacks per acre; Early Ohio potatoes, 160 sacks per acre; Danish Sludstrup mangel wurzel, 52,200 lbs. per acre; Half sugar mangel wurzel, 57,080 lbs. per acre; Danish Bald-head cabbage, 36,300 lbs. per acre; White Belgian stock carrot, 24,500 lbs. per acre; Danvers Half Long carrot, 30,200 lbs. per acre.

The work with Dry Land, Turkestan and Grimm alfalfa, started in

1917 has not as yet given any results. The seed bed was well prepared, and one-half of it received an application of lime at the rate of 2000 lbs. per acre. The plants showed little growth or color last fall and it seemed doubtful whether the plots would survive the winter. They were given a liberal application of manure, 20 loads per acre. During the summer the Grimm looked the most promising, having good sized crowns and a well developed root system.

In the seeding of a meadow mixture it was clearly demonstrated that one can be more certain of a stand if the seed is rolled into a well prepared seed bed rather than seeded with a nurse crop.

Buckwheat seems well adapted to this locality. It should be seeded at the rate of 30 lbs. per acre on or about the first of June, and requires a short period to mature, 8 to 10 weeks. The grain is used for human food, can make up part of a ration for poultry, swine or cows, produces a large amount of straw, and because of its quick growth makes a very good green manure. It does not tax the soil heavily.

Benefits from Clover.

The soil improvement and crop rotation experiments indicate some benefit from the application of commercial fertilizers. Wheat following a crop of clover shows a 45 per cent. increase in yield. The average increase in yield for the past three years, where wheat followed clover in a rotation, has been a little better than 50 per cent.

Apiculture.

Information given out relative to the possibilities of apiculture and to the need of the industry resulted in a 100 per cent. increase in the handling of bees. Colonies in and about Sandpoint were unable this year to gather surplus stores, but those in the fire weed districts have averaged 65 pounds of surplus honey to the colony. Important forage plants in honey production are dandelion, willow, white and alsike clover, willow-herb or fireweed, raspberry, goldenrod, and aster. Bees winter best in this section when packed in sawdust, using a standard 8 frame Langstroth hive. With the exception of the entrance, the entire hive should be insulated with a sawdust layer 6 to 10 inches deep. There should be at least 45 pounds of surplus honey store per hive.

Dairy Herd.

The average monthly milk yield of the cows in the dairy herd follows:

Edith	977.4 pounds	No. 32.....	486.3 pounds
Jennie	814.9 pounds	No. 35.....	687.1 pounds
Gameille	891.3 pounds	No. 28.....	680.6 pounds
Bess	775.4 pounds	No. 29.....	482.0 pounds
Prima	572.3 pounds		

The period covered by the records given above is January 1, 1918, to October 31, 1918, inclusive. The average monthly yield during this time for the nine head was 707.5 pounds, and average monthly test 3.17 per cent. The cow lowest in production gave 3374 pounds in 7 months or a monthly average of 482 pounds. The highest producing cow yielded 8797 pounds of milk in 9 months, a monthly average of 977.4 pounds.

Other Activities.

Although fewer home seekers visited the farm the past year as compared with the preceding one, more local farmers availed themselves of the experiment station service. Seed has been distributed and breeding animals sold at the lowest possible prices. In addition to the regular work on the farm, the Superintendent has given assistance in the organization of the Bonner County Farm Bureau, and acted for a time as County Agent. He has also answered numerous calls for advice and service from the territory within a considerable radius of Sandpoint.

FINANCIAL STATEMENT

University of Idaho Agricultural Experiment Station in account with the United States Appropriations.

Dr.	Hatch.	Adams.
Cr.	None	None
To balance from appropriation, 1916-1917.....		
Receipts from the Treasurer of the U. S. as per appropriations for fiscal year ended June 30, 1918, under acts of Congress approved March 2, 1887, (Hatch fund) and March 16, 1906, (Adams fund)	\$15,000.00	\$15,000.00
	Abstract	
Salaries	1 \$ 8,879.86	\$ 7,982.74
Labor	2 2,493.76	2,184.70
Publications	3 1,058.58	
Postage and Stationery.....	4 318.20	39.37
Freight and Express.....	5 154.98	251.85
Heat, Light, Water and Power.....	6 33.00	33.00
Chemicals and Laboratory Supplies.....	7 152.22	442.36
Seeds, Plants and Sundry Supplies.....	8 386.56	603.21
Fertilizers	9 3.65	212.75
Feeding Stuffs	10 874.30	234.20
Library	11 38.47	3.10
Tools, Machinery and Appliances.....	12 209.79	1,139.45
Furniture and Fixtures.....	13 102.91	61.00
Scientific Apparatus	14 199.30	918.83
Live Stock	15	
Traveling Expenses	16 61.85	868.84
Contingent Expense	17 20.00	
Buildings and Land.....	18 12.57	24.60
Balance		
	\$15,000.00	\$15,000.00

RECEIPTS IN LOCAL STATION FUND

January 1, 1918-December 31, 1918.

Source.	Amount.
Interest on Deposits.....	\$ 192.88
Horticulture	971.92
Agricultural Chemistry	26.90
Farm Crops	578.65
Animal Husbandry	384.10
Poultry	28.10
Soils	39.20
	\$ 2,221.75

DISBURSEMENTS

ITEM	Admin- istration	Animal Husbandry	Agr. Chemistry	Bacter- iology	Farm Crops	Horti- culture	Poultry	Soils	Total
Labor	\$ 48.20	\$127.00	\$ 9.50		\$429.55	\$418.47		\$ 10.00	\$1,042.72
Freight and Express ..	.53	.60			1.62	3.83		6.99	13.57
Supplies	24.75	311.03	2.75		52.35	143.58	11.20	11.25	556.91
Stationery and Postage ..	58.12		9.55		8.25				75.92
Traveling Expense ..	19.07							1.65	20.72
Feeding Stuffs		90.00				180.03	155.58		425.61
Library	20.00								20.00
Tools and Machinery		3.90			8.00	2.00	5.50	9.50	28.90
Scientific Apparatus			15.30					24.00	39.30
Furniture and Fixtures ..	69.30								69.30
Bulletins ..						102.80			102.80
Building and Repairs ..						17.45			17.45
Contingent Expense ..			5.00						5.00
	\$239.97	\$532.53	\$ 42.10		\$499.77	\$868.16	\$172.28	\$ 63.39	\$2,418.20

FINANCIAL STATEMENT

Substations' Receipts and Expenditures January 1, 1918-December 31, 1918.

Receipts:	Aberdeen	Caldwell	Gooding	Sandpoint
Balance on hand January 1, 1918.....	\$3,353.76	\$4,531.25	\$ 181.63	\$1,878.34
Station receipts from sale of live stock, hay, grain, potatoes, milk, etc., remitted to Boise		3,100.20		1,929.65
	\$3,353.76	\$7,631.45	\$ 181.63	\$3,807.99

Expenditures:

Salaries	\$ 895.00	\$2,729.16		\$1,969.96
Sundry Labor	211.20	1,154.00		43.55
Stationery and Office Supplies.....	2.50	2.25		1.75
Freight and Express.....	19.37	69.93		7.17
Bulletins and Publications.....	205.84	93.94	181.63	
Sundry Supplies	182.95	645.04		222.52
Traveling Expenses	222.32	121.59		32.55
Heat, Light, and Power.....	66.60	99.18		79.09
Telephone and Telegraph.....	33.59	29.05		27.10
Postage	2.50			8.00
Water		202.33		25.54
Feeding Stuffs	129.60	213.71		690.71
Tools and Machinery.....	154.83	554.91		498.47
Furniture and Fixtures.....	340.00			
Live Stock	240.00	610.00		379.00
Other Equipment	80.00	310.15		
Buildings and Repairs.....	110.79	1,759.86		76.51
Rentals				27.50
	\$2,897.09	\$8,595.10	\$ 181.63	\$4,089.42